1.14 Chemical processing personnel shall demonstrate a familiarity level knowledge of the principles and concepts of natural phenomena hazards and their effect on chemical processing systems.

General The impacts of natural phenomena on chemical processing systems are considered on a facility-by-facility or system-by-system basis, using a graded approach dependent on the structure, system, or component's (i.e. the SSC's) function. A SSC will be assigned a "Performance Category" reflecting risk to workers, the public, or the environment that will occur if it is damaged or destroyed. Each Performance Category has an associated "Performance Goal," which is the allowable probability for SSC failure to occur. In the discussion of impacts of natural phenomena hazards (NPHs) and their mitigation, the information will in general apply to the highest Performance Category (Performance Category 4, with a Performance Goal of loss of ability to maintain confinement at a probability of 10^{-5}), with lower Performance Categories subject to less stringent requirements. Principal references for NPH criteria are DOE-STD-1020-94, DOE-STD-1021-93, DOE-STD-1022-94, DOE-STD-1023-95, and DOE-STD-1024-94.

The impacts of the NPH are initially covered from a structural point of view since chemical processing systems may be subject to structural stresses. While the highly-radioactive chemical processing systems in nuclear facilities are generally located in containment structures, transfer systems (e.g. process waste lines) and critical support systems may be located outside. Additional information is then provided dealing with NPH impacts which are non-structural in nature.

a. Discuss the potential impact on chemical processing systems at defense nuclear facilities from the following natural hazards:

- Flooding
- Wind
- Tornado
- Earthquake and/or other seismic events
- Fire
- Lightning

Flooding

From a design basis standpoint, the design criteria for a SSC impacted by flooding are water damage, hydrostatic pressure on walls and roofs, and dynamic effects of erosion (shear), wind-wave action, and debris loads/impacts.

In a flooding event, the impact on facilities and components are the results of submergence, hydrostatic loads, and dynamic loads. Submergence can impact both exterior chemical processing components and internal components within a facility, causing loss of electrical power and/or failure of containment of radioactive or hazardous materials; it may render the facility unfit for future operation. Foundation settling may also occur. Hydrostatic loads must be considered in design of exterior chemical processing components located below the design basis flood level. Dynamic loads must be considered, such as the impact of wind-waves, ice flows, and debris, as well as erosion of foundations and protective dikes and levees.

For new facilities or exterior chemical processing components the easiest method to avoid a flooding event is to select a site above the design basis flood level, based on analysis of the probability of an initiating event: river flooding, dam or dike failure, storm surge, etc. To mitigate the impact of local precipitation, both sites and facilities should be designed for adequate drainage, and consideration given to ponding on roofs or elsewhere to level of a secondary drainage system. For existing sites with a significant risk of flooding, dikes, levees, and drainage features may be implemented; emergency action plans, flood recognition and early warning systems may allow operational response to flood events.

Additional flood impacts on chemical processing components are related to their location in facilities and their dependence on external support systems that may be impacted by flooding, such as cooling water, reagent tankage, water purification systems. Pipe trenches or similar structures may provide unintended flowpaths in a flood event. Submergence of systems and flooding of contaminated or controlled areas are typically the greatest concerns. The possibility of interior chemical processing components becoming submerged as a result of an independent accident or event (e.g. an earthquake rupture of a fire water main) must also be considered.

Typically chemical processing systems will shut down in a "fail-safe" mode, although some support systems such as ventilation must remain active. However, submergence or significant leakage can result in a significant loss of containment of radioactive or hazardous materials, potentially leading to a release to the environment. Additionally, water within storage areas for fissile materials can result in the potential for a nuclear criticality, and may have to be considered in the facility design.

Wind

From a design basis standpoint, the design criteria impacted by sustained wind are pressure on facilities and exterior chemical processing components (structures, walls, roofs, and distributed systems) and the impact of wind-driven missiles.

In a extreme wind event, the impact on facilities and structures from the pressures generated by the wind are lateral loading on structural surfaces and damage at corners and eaves (outward pressure on the downstream surface). In the event that the surface is breached (e.g. a door or window is broken, or a wind-driven missile penetrates), then interior pressure can develop causing other wall and roof surfaces (as well as interior walls) to be blown outward. Wind pressure may also cause problems with ventilation containment system pressure reversals. Damage to exterior coverings may allow water damage from stormwater to instrumentation, controls, or electrical components associated with chemical processing systems.

The impact on facilities from wind-driven missiles must be calculated based on an assumed condition. For Performance Category 4 SSCs, the assumed missile criteria is a 2X4 timber plank, 15 lb. at 50 mph (horizontal), maximum height of 50 ft above ground.

Features of facilities commonly used to mitigate impacts of extreme wind are additional structural supports, additional anchoring for external features, cross-bracing on walls and ceilings, and reinforced concrete external walls. Dynamic analysis (vibration response spectra) may be required for taller, thinner SSCs.

Tornado

From a design basis standpoint, the design criteria impacted by a tornado are pressure on walls and roofs, and the impact of wind-driven missiles.

In a tornado event, one impact on facilities from the pressures generated by the tornado winds are lateral loading on structural surfaces. This can generally be considered as translational force with no rotational component (the sum of the tornado rotational and translational velocities). Atmospheric pressure change (APC) between the vortex center and the radius of maximum wind can exert an outward force (suction) on walls and roofs causing other wall and roof surfaces (as well as interior walls) to be blown outward. APC may also cause problems with ventilation containment systems.

The impact on facilities from wind-driven missiles must be calculated based on an assumed condition. For Performance Category 4 SSCs, the assumed missile criteria are: a 2X4 timber plank, 15 lb. at 150 mph (horizontal), maximum height of 200 ft above ground, 100 mph (vertical); a 3 in. dia. steel pipe, 75 lb. at 75 mph (horizontal), maximum height of 100 ft above ground, 50 mph (vertical); and a tumbling 3000 lb. automobile, 25 mph.

Features of facilities commonly used to mitigate impacts of tornadoes are additional structural supports, cross-bracing on walls and ceilings, and reinforced concrete external walls. For “squat” facilities, static analysis is typically satisfactory, but dynamic analysis is required for taller, thinner SSCs.

Additional wind and tornado impacts on external chemical processing components are mainly due to the interaction between portions of a distributed support or waste transport systems and the potential for damage from structural failure of adjacent, lower Performance Category structures. Often, hazardous and flammable reagents are stored outside of nuclear facilities to reduce in-building risk. The potential for damage resulting in non-radioactive environmental releases from damage to outside reagent materials must be considered. Also, along with the vibrational failure potential with taller, narrower structures, smaller components may require analyses for rotational forces in tornado conditions. Both the structure and function of cooling tower and associated cooling water system are particularly subject to damage during a wind event.

Within a facility most chemical processing components would be expected to be protected by the facility structure or exterior covering. In the event that the facility walls or roof is breached, equipment may become exposed to water damage, and the possibility exists that interior walls may fail and damage adjacent equipment. Most interior chemical processing equipment designed for higher-pressure purposes (e.g. water, compressed gasses, etc.) will not be impacted by wind events, but stormwater may damage instrumentation, controls, or electrical components associated with these chemical processing systems.

Ventilation systems, which are the principal non-structural containment approach in nuclear chemical processing facilities, may have components on exposed portions of facilities where damage may compromise their function. Where ventilation control is used to contain radioactive or hazardous materials APC has the potential to cause pressurization and loss of control of material. HVAC control systems must be designed consistent with this NPH criteria. Additionally, the containment structure may be breached by wind-driven missiles, resulting in a facility shutdown or environmental release. High winds can also exacerbate contamination dispersal if a release occurs.

Earthquakeand/or Other Seismic Events

From a design basis standpoint, the design criteria impacted by a seismic event are the structural features necessary to prevent the collapse, loss of containment, toppling over, or vibrational damage of SSCs. Key differences are that seismic forces exert an impact not just on the walls and roof, but throughout the structure; and the need for dynamic analysis of SSCs. For chemical process systems in nuclear facilities handling large inventories of radioactive or fissile materials, this loss of containment results in potential for environmental release, the change in physical process configuration for increased potential of a nuclear criticality, and failure of support systems.

In a seismic event, the initiating event is lateral and vertical acceleration on a SSC. The probability/severity of seismic events are very location-specific, being much more frequent in areas of major faults. Within a general area, variation in immediate geology and foundation design will result in differing impacts on different SSCs. The impact of the seismic vibration or acceleration will be amplified from the movement of soil, with the amplification being generally less for SSCs with foundations closer to or attached to bedrock, and with larger and more rigid foundations. Within a larger structure amplification and damping of seismic vibrations will also occur, so SSCs located within that structure must be analyzed base on the local vibration spectra. Impact on the facility will be collapse of members and rocking and rolling of components. Interaction between SSCs must be considered from structural failing and falling, proximity, flexibility of lines an attached cables, flooding or exposure to fluids from ruptured vessels, piping systems and dams, and effects of seismically-induced fires.

Features of facilities commonly used to mitigate impacts of seismic events are evaluation of event probability and seismic dynamic modeling and analysis, which generally results in strengthening, stiffening, and buttressing structures or designs, and modifying foundations and siting. The general approach is to use a probabilistic basis to select the design load, and then use deterministic approaches to evaluate the permissible response levels and perform design calculations. For SSCs within a larger structure, method to mitigate seismic impacts are seismic qualification of purchased components, analysis of anchoring requirements, additional points of attachment, and other means of dampening modes of vibration. Single point failures must be analyzed.

For existing facilities, analyses must be performed as to their seismic risk. Remedying unsatisfactory conditions will be based on relative risk and intended length of future service. For smaller components, testing (i.e. shake table qualification) and use of past earthquake and testing experience data are also acceptable (and sometimes preferred) approaches.

Operational mitigation of seismic risk is provided by the facility safety analysis report, which will bound facility risks and conditions and set requirements on facility procedures, classification of components, allowable inventory, and similar operational parameters. Additional quality assurance of components and peer review of designs and modifications is required to assure as-built and ongoing facility risk.

Additional seismic impacts on chemical processing components such as vessels or gloveboxes are related to their anchoring (do they move or topple), their response to vibration, and their interaction with system and adjacent components. Typical design features used for chemical processing components are dampened mounting and support of equipment to dampen or change the mode of vibration while providing a secure anchoring. Flexible couplings may be provided for piping systems. In some cases smaller components or control system elements mounted to isolate them from seismic forces and vibration.

Seismic qualification of components based on shake table testing or other methods as called out in IEEE 344 or equivalent standard needs to be performed if a components is required to maintain its function in the design basis event.

The interaction concerns are further divided into:

- Failure or falling of other, lower performance category systems, causing damage to a given system
- Proximity to other systems (vibration, impact)
- Flexibility of attached lines and cables
- Flooding/exposure to fluids from ruptured vessels, and
- Seismically induced-fires

Typically chemical processing systems will shut down in a “fail-safe” mode, although some support systems such as ventilation must remain active. However, breach of confinement systems can result in a significant loss of containment of radioactive or hazardous materials, potentially leading to a release to the environment or worker hazards.

Additionally, movement of containers within fissile materials storage areas can result in the potential for a nuclear criticality, and must be considered in the facility design.

Fire

From a design basis standpoint, the design criteria for fire protection are extensively covered in stand-alone requirements specific to the fire-protection discipline. Primary features to be systematically included at each site include site-specific fire protection criteria and a system to ensure that the requirements of the DOE fire protection program are documented and incorporated into the plans and specifications for all new facilities and for significant modifications of existing facilities. Fire hazards analysis (FHA) are required for all nuclear facilities, significant new facilities and facilities that represent unique or significant fire safety risks.

While fire hazards are of significant concern for the operation of nuclear facility chemical processing systems, particularly HVAC containment systems, the principal postulated accidents are from fires initiated within the facility. For a fire hazard to be considered a NPH, the fire would be an external or outside hazard. Thus, the impacts of such a fire are as an initiator for internal facility fires and on safety systems located externally to the facility.

Impacts of external fires on internal systems are largely mitigated by the nature of nuclear facilities, in that for seismic and other reasons the facilities are largely concrete and not generally flammable. While roofing materials are often flammable, the typical buffer zones surrounding the larger facilities and the height of the roofs provide some measure of isolation from an external fire heat source. Air intakes for ventilation systems could also provide a fire path; however, conditioning (heating and cooling) systems provide some protection against both initiation of internal fires and smoke hazards. Ventilation intake systems may have to be turned off or switched to recycle as a mitigation measure for an external fire.

External chemical processing equipment may be subject to fire damage, especially distributed support systems (e.g. above-ground waste lines) and cooling water systems. Many cooling towers are wood, and subject to fire damage. Externally-located tanks and piping for flammable reagents and emergency system fuel (e.g. solvent extraction organic make-up and fuel for emergency generators) may be at risk and provide secondary sources of fuel. Finally, power distribution systems may be subject to damage in a fire, causing a loss of power to chemical processing systems. Principal standards covering external fires are DOE O 5480.7A, FIRE PROTECTION; NFPA 295, Wildfire Control; and NFPA 299, Wildfire, Protection of Life and Property.

Lightning

From a design basis standpoint, the design criteria impacted by lightning are the SSCs which may be adversely affected by a high-voltage surge of electricity of short duration. A lightning protection system has the objective of conducting to ground the lighting that may strike a building without causing damage to the building and equipment within the structure or exposing occupants of the building to injury. Electrical systems, in particular, should be protected from damage to conductor, insulation and electrical equipment.

Lightning may cause over-voltages in electrical circuits either by direct stroke on an outdoor transmission line or by electrostatic induction from a stroke to earth near the line. Either of such strokes can send large quantities of electric charges along the line in both directions from the stricken point to ultimate ground. The rate of rise of voltage along the line can be very rapid.

Direct-stroke over-voltages may be on the order of millions of volts and several hundred-thousand amp. Induced strikes, which occur more frequently, may be several hundred-thousand volts with currents ranging from 50 to 2,000 amp.

Features of facilities commonly used to mitigate impacts of lightning strikes include the installation of conductors that extend from points above the roof to the ground and installation of lightning arrestors connecting ungrounded conductors to ground.

Additional impact to chemical processing systems from lightning strikes are associated with the electrical surge being conducted along metal chemical processing components, with melting or arcing at points of high resistance and damage to control systems. Reagent systems with flammable gasses and liquids are vulnerable to lightning-induced fires. Externally-located microprocessor-based control systems are especially vulnerable to lightning damage.

b. Briefly describe the safety measures and design features commonly used as safeguards against natural hazards.

Safety measures and design features used to mitigate the effects of floods are:

- Siting of the SSC above the design basis flood;
- Dikes and levees to keep elevated waters away for the facility;
- Development of emergency implementation plans and early warning systems;
- Design of sites with adequate drainage for abnormal levels of precipitation;
- Design of secondary drainage systems to preclude problems from pluggage of primary drainage systems (roofs and local areas of sites); and
- Sealing and hardening of SSC to prevent water damage.

Safety measures and design features used to mitigate the effects of sustained winds are:

- Strengthening of surfaces of facilities to account for lateral and vertical wind loading;
- Design of facilities for internal pressures generated by extreme winds;
- Facility cladding and roofing to mitigate surface damage;
- Design for wind-driven missile damage; and
- Emergency plans and early warning systems to warn of and prepare for severe storms.

Safety measures and design features used to mitigate the effects of tornadoes are:

- Strengthening of surfaces of facilities to account for lateral and vertical wind loading, and APC conditions;
- Design of facilities for internal pressures generated by extreme winds;
- Facility cladding and roofing to mitigate surface damage;
- Design for wind-driven missile damage; and
- Emergency plans and early warning systems to warn of and prepare for severe storms.

Safety measures and design features used to mitigate the effects of earthquakes are:

- Siting of facilities in areas of low seismic activity;
- Modeling, designing and modifying facilities to withstand appropriate seismic loads;
- Developing safety analyses and adherence to operational requirements to assure that facilities operate within an adequate safety envelope; and
- Equipment qualifications, installation, internal design, and quality control to assure component performance.

Safety measures and design features used to mitigate the effects of fires are:

- A reliable water supply of adequate capacity for fire suppression;
- Non-combustible or fire resistive construction, where appropriate;
- Automatic fire extinguishing systems throughout all significant facilities and in all areas subject to loss of safety class systems, significant life safety hazards, unacceptable program interruption, or fire loss potential in excess of defined limits;
- Redundant fire protection systems where appropriate;
- A means to summon the fire department in the event of a fire;
- A means to notify and evacuate building personnel in the event of a fire; and
- Physical access and appropriate equipment to facilitate effective intervention by the fire department.

Safety measures and design features used to mitigate the effects of lightning are:

- Site safety practices which address work out-side during periods of observed lightning activity;
- Installation of conductors that extend from points above the roof to the ground; and
- Installation of lightning arrestors connecting ungrounded conductors to ground.

2.7 Chemical Processing personnel shall demonstrate a familiarity level knowledge of the following Department of Energy (DOE) Standards and the Order related to natural phenomena hazards:

- DOE-STD-1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities
- DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components
- DOE-STD-1022-94, Natural Phenomena Hazards Site Characterization Criteria
- DOE Order 5480.28, Natural Phenomena Hazards Mitigation

a. Describe the purpose, scope, and application of the requirements detailed in the listed standards and the Order.

DOE-STD-1020-94

Purpose: This DOE Standard gives design and evaluation criteria for Natural Phenomena Hazards (NPH) effects as guidance for implementing the NPH mitigation requirements of DOE Order 420.1 and the associated implementation guides. It is intended to provide consistent design and evaluation criteria for protection against NPH at DOE sites throughout the United States.

Scope: The design and evaluation criteria presented by this standard are meant to control the level of conservatism introduced into the design/evaluation process such that earthquake, wind, and flood hazards are treated on a consistent basis. These criteria also employ a graded approach to ensure that the level of conservatism and rigor in design/evaluation is appropriate for facility characteristics such as importance, hazards to people on and off site, and threat to the environment. For each natural phenomena covered, these criteria consist of the following:

- Performance categories and target performance goals as specified in the DOE Order 420.1 NPH Implementation Guide and DOE-STD-1021;
- Specified probability levels from which NPH loading on structures, equipment, and systems is developed; and
- Design and evaluation procedures to evaluate response to NPH loads and criteria to assess whether or not computed response is permissible.

Application: These criteria apply to the design of new facilities and the evaluation of existing facilities. They may also be used for modification and upgrading of existing facilities as appropriate. The application of NPH design requirements to structures, systems and components (SSCs) shall be based on the life-safety or the safety classifications for the SSCs as established by safety analysis.

DOE-STD-1021-93

Purpose: This DOE Standard gives design and evaluation criteria for NPH for selecting performance categories (PCs) of SSCs in accordance with the requirements specified in DOE order 420.1 and the associated implementation guides. It also recommends procedures for consistent application of the determined PC criteria so that the DOE review and approval process is simplified.

Scope: The criteria and recommendations presented in this standard shall apply to performance categorization of SSCs for the purpose of mitigating natural hazards phenomena in all DOE facilities covered by DOE Order 420.1.

Application: The provisions of this standard apply only to NPH evaluation of SSCs. Application of basic categorization guidelines presented in this standard will establish the preliminary performance category of SSCs. The procedural steps presented are general recommendations for NPH performance categorization only, and are not intended to provide procedures for performing facility safety reviews or accident analyses.

DOE-STD-1022-94

Purpose: This DOE Standard provides criteria for site characterization to provide site-specific information for implementing the requirements of DOE order 420.1 and the associated implementation guides. Additionally, the purpose of this standard is to develop a sitewide database related to NPH that should be obtained to support individual safety analysis reports (SARs). Appropriate approaches are outlined to ensure that the current state-of-the-art methodology is being used in the site characterization.

Scope: The criteria and recommendations in this standard shall apply to site characterization for the purpose of mitigating NPH in all DOE facilities covered by DOE Order 420.1. Criteria for site characterization not related to NPH are generally not included in this document unless they are deemed necessary for clarification. General and detailed site characterization requirements are provided in the areas of meteorology, hydrology, geology, seismology and geotechnical studies.

Application: The criteria and recommendations in this standard shall apply to site characterization for the purpose of mitigating the effects of NPH in all DOE facilities covered by DOE Order 420.1.

DOE Order 5480.28

This Order has been canceled and replaced by new Order **DOE O 420.1, Facility Safety,** effective 10-13-95. For the purpose of this study guide the new order will be discussed.

Purpose : This order establishes facility safety requirements related to: nuclear safety design, criticality safety, fire protection and natural hazards mitigation. NPH Mitigation is covered in detail in section 4.4 of this Order. With regards to NPH, the order provides requirements to ensure that all DOE facilities are designed, constructed, and operated so that the general public, workers, and the environment are protected from the impact of NPH. The provisions of section 4.4 cover all NPH such as seismic, wind, flood and lightning.

Scope : The Order includes provisions for general design requirements, NPH mitigation design requirements, evaluation and upgrade of existing DOE facilities, NPH assessment, natural phenomena detection, and post-natural phenomena procedures.

Applicability: The NPH mitigation requirements are applicable to DOE facilities including the following: new nuclear; new non-nuclear; existing nuclear; existing non-nuclear; modifications to nuclear, modifications to non-nuclear, accelerators and fusion facilities; and new, existing and modifications to weapons facilities. Facility and applicability requirements are defined in Attachment 1, Table 1.

b. Discuss the graded approach process that Department line management uses to determine an appropriate level of coverage by chemical process systems personnel. Include in this discussion the factors that may influence the level of coverage.

DOE Order 420.1 and the associated Implementation Guides establish a graded approach in which NPH requirements are provided for various performance categories, each with a specified performance goal. The graded approach enables design or evaluation of DOE SSCs to be performed in a manner consistent with their importance to safety, importance to mission, and cost. The graded approach enables cost-benefit studies and establishment of priorities for existing facilities. Probabilistic performance goals enable the development of consistent criteria both for all natural phenomena hazards and for all DOE facilities which are located throughout the United States.

Five performance categories are specified for the design/evaluation of DOE SSCs for NPH ranging from 0 through 4 as follow:

(0) No safety, mission, or cost considerations;
(1) Maintain Occupant Safety;
(2) Occupant safety, continued operation with minimum interruption;
(3) Occupant safety, continued operation, hazard confinement; and
(4) Occupant safety, continued operation, confidence of hazard confinement SSCs are to be placed in categories in accordance with DOE-STD-1021-93.

Quantitative performance goal probability values are applicable to each NPH (earthquake, wind, and flood) individually. DOE-STD-1020-94 provides earthquake and flood design and evaluation criteria for the DOE. Appropriate performance goals are set for each performance category SSC.

Coverage by mechanical system resources may be effectively assigned utilizing the evaluation approach for an existing SSC as defined in DOE-STD-1020-94. That process includes the following elements:

- Collect design documents, conduct Site visit & operator interviews. Note differences between design & as-is condition. Determine performance categories for mechanical systems. Calculate as-is NPH capacity/demand by DOE-STD-1020;

- If criteria are met, the system is adequate for natural phenomena hazards;
- If criteria are not met, alternate options must be considered;
- Upgrade easy-to-remedy deficiencies or weaknesses;
- If upgrades are sufficient, system is adequate for NPH;
- If close to meeting criteria, reevaluate using hazard probability of twice the recommended value;
- If unsuccessful, conduct more rigorous evaluation removing added conservatism introduced by initial evaluation methods;
- If successful, system is adequate for NPH; and
- If unsuccessful and a backfit analysis indicates more work is necessary, strengthen system sufficiently to meet DOE-STD-1020 or change the usage of the SSC to a category with less stringent requirements.

c. Determine contractor compliance with the listed documents as they apply to contract design requirements and chemical process system activities at a Department defense nuclear facility.

Natural Phenomena Hazards Mitigation – The contractor is responsible to ensure that all DOE facilities are designed, constructed, and operated so that the general public, workers, and the environment are protected from the impact of NPH. The provisions of this requirement apply to DOE sites and facilities and they cover all natural phenomena hazards such as seismic, wind, flood, and lightning. Where no specific requirements are specified, model building codes or national consensus industry standards shall be used.

General Requirements – For hazardous facilities, safety analyses shall include the ability of SSCs and personnel to perform their intended safety functions under the effects of natural phenomena.

Natural Phenomena Mitigation Design Requirements – SSCs shall be designed, constructed and operated to withstand the effects of natural phenomena as necessary to ensure the confinement of hazardous material, the operation of essential facilities, the protection of government property, and the protection of life safety for occupants of DOE buildings. The design process shall consider potential damage and failure of SSCs due to both direct and indirect natural phenomena effects, including common cause effects and interactions from failures of other SSCs. Furthermore, the seismic requirements of Executive Order 12699 shall be addressed.

SSCs for new DOE facilities, and additions or major modifications to existing SSCs shall be designed, constructed and operated to meet the requirements in the previous paragraph. Any additions and modifications to existing DOE facilities shall not degrade the performance of existing SSCs to the extent that the objectives in this Section cannot be achieved under the effects of natural phenomena.

Evaluation and Upgrade of Existing DOE Facilities – SSCs in existing DOE facilities shall be evaluated when there is a significant degradation in the safety basis for the facility. Furthermore, the seismic requirements of Executive Order 12941 shall be addressed.

If any of the conditions above are satisfied, then the contractor/operator shall establish a plan for evaluating the affected systems, structures, and components. The plan shall incorporate a schedule for evaluation taking into account programmatic mission considerations and the safety significance of the potential failure of systems, structures and components due to natural phenomena.

If the evaluation of existing SSCs identifies natural phenomena mitigation deficiencies, the contractor/operator shall establish an upgrade plan for the affected SSCs.

The upgrade plan shall incorporate a prioritized schedule for upgrading the SSCs. The upgrade plan shall address possible time or funding constraints as well as programmatic mission considerations.

Natural Phenomena Hazards Assessment – The design and evaluation of facilities to withstand natural phenomena shall be based on an assessment of the likelihood of future natural phenomena occurrences. The NPH assessment shall be conducted commensurate with a graded approach and commensurate with the potential hazard of the facility.

For new sites, NPH assessment shall be conducted commensurate with a graded approach to the facility. Site planning shall consider the consequences of all types NPH. For existing sites, if there are significant changes NPH assessment methodology or site-specific information, the NPH assessments shall be reviewed and shall be updated, as necessary. A review of the NPH assessment shall be conducted at least every 10 years. The review shall include recommendations to DOE on the need for updating the existing NPH assessments based on identification of any significant changes in methods or data.

Natural Phenomena Detection – Facilities or sites with hazardous materials shall have instrumentation or other means to detect and record the occurrence and severity of seismic events.

Post-Natural Phenomena Procedures – Facilities or sites with hazardous materials shall have procedures that include, inspecting the facility for damage caused by severe natural phenomena, and placing the facility into a safe configuration when such damage has occurred.